IPv6 support in the DNS

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Agenda

- How important is the DNS?
- DNS Resource Lookup
- DNS Extensions for IPv6
- Lookups in an IPv6-aware DNS Tree
- About Required IPv6 Glue in DNS Zones
- The Two Approaches to the DNS
- DNS IPv6-capable software
- IPv6 DNS and root servers
- DNSv6 Operational Requirements & Recommendations
How important is the DNS?

- Getting the IP address of the remote endpoint is necessary for every communication between TCP/IP applications.

- Humans are unable to memorize millions of IP addresses (specially IPv6 addresses).

- To a larger extent: the Domain Name System (DNS) provides applications with several types of resources (domain name servers, mail exchangers, reverse lookups, ...) they need.

- DNS design
  - hierarchy
  - distribution
  - redundancy
DNS Lookup

Query 'foo.g6.asso.fr' RR?
Refer to fr NS + glue
Query 'foo.g6.asso.fr' RR?
Refer to asso.fr NS [+ glue]
Query 'foo.g6.asso.fr' RR?
Refer to g6.asso.fr NS [+ glue]
Query 'foo.g6.asso.fr' RR?
RR for foo.g6.asso.fr

root

fr
de
com
asso
inria
abg
afnic
g6
DNS Extensions for IPv6

RFC 1886 → RFC 3596 (upon successful interoperability tests)

**AAAA**: forward lookup (‘Name IPv6 → Address’):
   Equivalent to ‘A’ record
   Example:
   ns3.nic.fr. IN A 192.134.0.49
   IN AAAA 2001:660:3006:1::1:1

**PTR**: reverse lookup (‘IPv6 Address → Name’):
   Reverse tree equivalent to in-addr.arpa
   New tree: ip6.arpa (under deployment)
   Former tree: ip6.int (deprecated)

Example:
$ORIGIN 1.0.0.0.6.0.0.3.0.6.6.0.1.0.0.2.ip6.arpa.
1.0.0.0.1.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0 PTR ns3.nic.fr.
Lookups in an IPv6-aware DNS Tree

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### About Required IPv6 Glue in DNS Zones

When the DNS zone is delegated to a DNS server (among others) contained in the zone itself

Example: In zone file `rennes.enst-bretagne.fr`

<table>
<thead>
<tr>
<th>Type</th>
<th>Name</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>@</td>
<td>SOA</td>
<td><code>rsm.rennes.enst-bretagne.fr. fradin.rennes.enst-bretagne.fr.</code> (2005040201 ;serial 86400 ;refresh 3600 ;retry 3600000 ;expire)</td>
</tr>
<tr>
<td>IN</td>
<td>NS</td>
<td><code>rsm</code></td>
</tr>
<tr>
<td>IN</td>
<td>NS</td>
<td><code>univers.enst-bretagne.fr.</code></td>
</tr>
<tr>
<td>[...]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ipv6</td>
<td>IN</td>
<td><code>rsm</code></td>
</tr>
<tr>
<td>ipv6</td>
<td>IN</td>
<td><code>ns3.nic.fr.</code></td>
</tr>
<tr>
<td>ipv6</td>
<td>IN</td>
<td><code>rsm</code></td>
</tr>
<tr>
<td>;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ipv6</td>
<td>IN A</td>
<td><code>192.108.119.134</code></td>
</tr>
<tr>
<td>ipv6</td>
<td>IN AAAA</td>
<td><code>2001:660:7301:1::1</code></td>
</tr>
</tbody>
</table>

IPv4 glue (A 192.108.119.134 ) is required to reach `rhadamanthe` over IPv4 transport
IPv6 glue (AAAA 2001:660:7301:1::1) is required to reach `rhadamanthe` over IPv6 transport
IPv6 DNS and root servers

- DNS root servers are critical resources!
- 13 roots « around » the world (#10 in the US)
- Not all the 13 servers already have IPv6 enabled and globally reachable via IPv6.
- Need for (mirror) root servers to be installed in other locations (EU, Asia, Africa, …)
- New technique: anycast DNS server
  - To build a clone from the master/primary server
  - Containing the same information (files)
  - Using the same IP address
- Such anycast servers have already begun to be installed:
  - F root server: Ottawa, Paris (Renater), Hongkong, Lisbon (FCCN)…
**NEWS**

<table>
<thead>
<tr>
<th>Date</th>
<th>Subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004-01-29</td>
<td>New IP address for b.root-servers.net (192.228.79.201)</td>
</tr>
<tr>
<td>2004-01-26</td>
<td>New AS number for i.root-servers.net</td>
</tr>
</tbody>
</table>

**PRESENTATIONS**

<table>
<thead>
<tr>
<th>Date</th>
<th>Occasion</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003-03-24</td>
<td>GAC meeting during ICANN meeting in Rio de Janeiro (PDF)</td>
</tr>
<tr>
<td>2003-12-09</td>
<td>WSIS meeting in Geneva (PDF)</td>
</tr>
</tbody>
</table>

**SERVERS**

<table>
<thead>
<tr>
<th>Server</th>
<th>Operator</th>
<th>Locations</th>
<th>IP Addr</th>
<th>Home ASN</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>VeriSign Naming and Directory Services</td>
<td>Dulles VA</td>
<td>198.41.0.4</td>
<td>19836</td>
</tr>
<tr>
<td>B</td>
<td>Information Sciences Institute</td>
<td>Marina Del Rey CA</td>
<td>IPv4: 192.228.79.201</td>
<td>tba</td>
</tr>
<tr>
<td>C</td>
<td>Cogent Communications</td>
<td>Herndon VA; Los Angeles; New York City; Chicago</td>
<td>192.33.4.12</td>
<td>2149</td>
</tr>
<tr>
<td>D</td>
<td>University of Maryland</td>
<td>College Park MD</td>
<td>128.8.10.90</td>
<td>27</td>
</tr>
<tr>
<td>E</td>
<td>NASA Ames Research Center</td>
<td>Mountain View CA</td>
<td>192.203.230.10</td>
<td>297</td>
</tr>
<tr>
<td>F</td>
<td>Internet Systems Consortium, Inc.</td>
<td>- 40 sites:</td>
<td>IPv4: 192.5.5.241</td>
<td>3557</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ottawa; Palo Alto; San Jose CA; New York City; San Francisco; Madrid; Hong Kong; Los Angeles; Rome; Auckland; Sao Paulo; Beijing; Seoul; Moscow; Taipei; Dubai; Paris; Singapore; Brisbane; Toronto; Monterrey; Lisbon; Johannesburg; Tel Aviv; Jakarta; Munich; Osaka; Prague; Amsterdam; Barcelona; Nairobi;</td>
<td>IPv6: 2001:500:1035</td>
<td></td>
</tr>
</tbody>
</table>
The Two Approaches to the DNS

- The DNS seen as a Database
  - Stores different types of Resource Records (RR): SOA, NS, A, AAAA, MX, SRV, PTR, …
  
  DNS data is independent of the IP version (v4/v6) the DNS server is running on!

- The DNS seen as a TCP/IP application
  - The service is accessible in either transport modes (UDP/TCP) and over either IP versions (v4/v6)
  
  Information given over both IP versions MUST BE CONSISTENT!
DNS IPv6-capable software

- **BIND (Resolver & Server)**
  - BIND 9 (avoid older versions)
- **On Unix distributions**
  - Resolver Library (+ (adapted) BIND)
- **NSD (authoritative server only)**
  - http://www.nlnetlabs.nl/nsd/
- **Microsoft Windows (Resolver & Server)**
  ...
DNSv6 Operational Requirements & Recommendations

• The target today IS NOT the transition from an IPv4-only to an IPv6-only environment

• How to get there?
  – Start by testing DNSv6 on a small network and get your own conclusion that DNSv6 is harmless, but remember:
    • **The server (host) must support IPv6**
    • **And DNS server software must support IPv6**
  – Deploy DNSv6 in an incremental fashion on existing networks
  – DO NOT BREAK something that works fine (production IPv4 DNS)!
Questions?